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(54) Machine for Cleaning Surfaces Such as Carpets, Floors and the Like

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MACHINE FOR CLEANING SURFACES SUCH AS CARPETS, FLOORS AND THE LIKE

ABSTRACT

A machine for cleaning surfaces such as carpets, floors, and the like, has a frame (30) on which is mounted an upper housing (56) containing an air pump (62). An assembly of a fresh liquid container (48) stacked on a waste liquid container (50) is removably mounted on the frame with the aide of a cam latch (54). The air pump communicates with a housing (160) which provides pressurized air to outlets (158, 166, and 168) and suction to a suction nozzle (46) through a conduit (173) which carries waste liquid and air picked up from the carpet to a separator (58) in the housing (56). A cleaning fluid container (64) is removably mounted in a docking port (68) in the housing (56) and aligned and locked in communication with couplings (254) in the docking port (68) by a rotatable collar (66) having a camming recess (220). The clean liquid container (48) and the cleaning fluid container are pressurized by connections thereto from the air pump outlets (166 and 168) to provide for the delivery of fresh liquid or fresh liquid and cleaning solution mixtures of selected concentration to a spray nozzle (42) to which pressurized air is also applied from one of the pressurized air outlets (164) via a conduit (158). The delivery and concentration of the fresh liquid and/or cleaning fluid is controlled by a actuator (40) which operates a rocker arm (102) for

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constricting tubing associated with a coupling (90, 126) in which the pressurized cleaning fluid and fresh liquid are combined. The suction nozzle has a passage (274, 276) for facilitating flow of air and waste water and making such flow visible. The separator (58) includes a conical shroud (172) which facilitates separation of waste liquid from the air picked up from the surface being cleaned. The assembly of fresh water and waste water tanks (48, 50) has a conduit (181) leading from the bottom of the separator housing (160) through the fresh liquid tank into the waste liquid tank. A keyway (184) on the tanks facilitates their alignment with a member on the frame (30) containing the conduits (158 and 173) for the pressurized air to the spray nozzle and the air and waste liquid from the suction nozzle and which provides a key for alignment of the assembly of containers (48 and 50) on the frame (30). The cleaner may be rolled on wheels (32) by a handle (36) connected to the frame (30).

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A machine for cleaning surfaces, such as carpets, floors and the like which comprises a frame, an air pump mounted on said frame, a housing communicating with said pump and having a suction inlet and pressurized air outlets, a suction nozzle mounted on said frame at the end thereof disposed adjacent to the surface to be cleaned, a liquid projecting nozzle also mounted on said frame at said end, a plurality of containers for concentrated cleaning liquid, fresh and waste liquid, said containers being removably mounted to said frame and said housing, with a conduit connecting said housing and said waste liquid container to communicate waste liquid separated from the air and waste liquid transported into said housing into said waste liquid container, a conduit for air and waste liquid from said suction nozzle to said suction inlet, said pressurized air outlets being in communication with said cleaning liquid container and said fresh liquid container for the pressurization thereof, a coupling connected to outlets from said fresh liquid and cleaning liquid containers in which said fresh and cleaning liquids flow together to an outlet, and said coupling outlet being connected to said liquid projecting nozzle to apply said fresh and cleaning liquids to said surface.

2. The machine according to Claim 1 further comprising a controller for the flow of pressurized liquid from said fresh liquid tank into said coupling and of liquid from the outlet of said coupling to said liquid projecting nozzle to avary the amount and concentration of cleaning to fresh liquid flowing to said liquid projecting nozzle.

3. The machine according to Claim 2 wherein said coupling has inlets for pressurized fresh liquid and for liquid containing said pressurized cleaning fluid, flexible tubing connected to at least one of said inlets and said outlet, said controller comprising an actuable member for selectively constricting said tubing.

4. The machine according to Claim 3 wherein said coupling comprises a block having a passage with inlets for said pressurized fresh liquid and said pressurized cleaning fluid which inlets oppose each other, said passage having a constricted region, a first outlet from said block connected to said passage on the side of said region adjacent to said fresh liquid inlet, a second outlet from said block connected to said passage on the side of said region adjacent to said cleaning liquid inlet, said outlets providing said inlets to least one of which said tubing is connected, said coupling also comprising a connector to which said outlets from said block are connected, said flexible tubing connecting at least said first outlet to said connector, said connector having an outlet providing said outlet from said coupling which is connected to said spray nozzle by flexible tubing, said controller comprising a rocker arm having a pivot and pivotable thereabout to control said amount and concentration of fresh liquid and cleaning liquid, members on opposite sides of said pivot for engaging and constricting the tubing connecting said connector outlet to said spray nozzle, engaging and constricting the tubing connecting said first outlet to said connector, or being disposed space from said tubing to leave said tubing unrestricted.

5. The machine according to Claim 1 wherein said liquid projecting nozzle has at least one channel providing an exit opening from said liquid projecting nozzle, a conduit communicating pressurized air from at least one of said pressurized air outlets to said channel, a tube located within said channel and having an exit opening spaced inwardly from said channel exit opening, and said tube being connected to said coupling output.

6. The machine according to Claim 5 wherein said liquid projecting nozzle has a housing, a fan-shaped array of a plurality of said channels in said housing, a plurality of tubes each in a different one of said channels, each tube having its exit opening space inwardly from the exit opening of the channel in which it is disposed, a manifold connected to the ends of said tubes opposite to their exit openings, and said coupling output being connected to said manifold.

7. The machine according to Claim 1 wherein said air pump has an exit chamber defining a flow of air in an annular path into a region of said housing, and said pressurized air outlets communicating with said region.

8. The machine according to Claim 7 wherein said housing has an annular outer wall a portion of which defines said region having said pressurized air outlets, said suction inlet being disposed tangentially to said outer wall to define a flow of said air and waste liquid from said conduit from said suction nozzle in an annular path around said housing, an inlet for said air to said air pump disposed centrally of said housing, and a shroud about said air inlet tapering outwardly to an open end of said shroud which faces the bottom of said housing whereby said housing and shroud cooperate to separate waste liquid from the air picked up by said suction nozzle.

9. The machine according to Claim 1 wherein said fresh liquid container is stackable upon said waste liquid container to provide an assembly removably mounted on said frame.

10. The machine according to Claim 9 wherein said housing is open at the bottom, said waste liquid container having an opening at the top thereof, said fresh liquid container having a central passage, said conduit for said waste liquid being part of said removable assembly of said waste liquid and fresh liquid containers, said conduit extending through said passage in said fresh liquid container and being connected at its lower end to said opening in the top of said waste liquid container and at its upper end to said opening in said housing.

11. The machine according to Claim 9 wherein said waste liquid and fresh liquid containers have keyways in one side thereof which keyways are aligned with each other when said containers are assembled, a member having at least one passage therethrough to provide said conduit for waste liquid and air picked up from said surface disposed on said frame and defining a key for receiving said keyways and aligning said waste liquid and fresh liquid containers on said frame.

12. The machine according to Claim 11 further comprising a pivotal lever mounted on said frame and having a cam surface engagable with an outer wall surface of said waste liquid tank for releaseably securing said assembly on said frame.

13. The machine according to Claim 1 wherein said suction nozzle has a passage triangular in shape and wide at its base, which base provides an opening disposable adjacent to said surface, said passage being

narrow at its upper end to provide an outlet, the width of said passage increasing from said base to said outlet such that the cross-sectional area across the flowpath through said passage remains substantially equal between the inlet and outlet whereof.

14. The machine the according to Claim 1 wherein said suction nozzle has a first passage and a second passage, said second passage being connected to said air and waste liquid conduit, said first passage is extending downwardly to the surface to be cleaned, and said second passage extending horizontally and defining a trough.

15. The machine according to Claims 13 or 14 wherein said suction nozzle comprises lower and upper pieces, which defines said passages, said lower piece being disposed between said surface to be cleaned and said upper piece, and said upper piece being sufficiently transparent to make visible the liquid picked up from said surface.

16. The machine according to Claim 1 wherein said housing has a docking port for said cleaning liquid container including a coupling for the passage of pressurized air into said cleaning liquid container and for the passage of pressurized cleaning liquid from said cleaning liquid container, at least one lug extended from said docking port, said cleaning liquid container having at an end thereof ports for connection to said coupling to interconnect with said air and cleaning liquid passages therein, a collar rotatably mounted on said cleaning liquid container, said collar having an opening with an inclined cam surface for receiving said lug, and a handle for rotating said collar to move said container in said docking port and bring said ports into communicating engagement with said passages in said coupling.

17. The machine according to Claim 16 wherein said docking port has keys and said container has indentations which receive said keys for guidance and alignment of said container in said docking port when said collar is rotated.

18. A cleaning device comprising:

a spray nozzle,

a mixing means for mixing water and cleaning fluid having an outlet connected to said spray nozzle, a fitting providing a water inlet and a cleaning fluid inlet to said mixing means, said inlets being separate from each other;

a pressurized source of water connected to said water inlet;

a pressurized source of cleaning fluid connected through said fitting to said cleaning fluid inlet; and

a passage in said fitting communicating pressurized water from said pressurized water source to said cleaning fluid inlet.

19. A cleaning device according to Claim 18 wherein said sources of water and cleaning fluid each include a container, and further comprising a pump connected to both said containers to pressurize them during operation of said cleaning device.

20. A cleaning device according to Claim 19 wherein said pump includes a primary outlet connected to said spray nozzle and a pair of secondary outlets connected respectively to said water and cleaning fluid containers for the pressurization thereof.

21. A cleaning device according to Claim 20 wherein said primary outlet has substantially greater cross-sectional area across the flowpath therethrough than said secondary outlets.

22. A cleaning device according to Claim 18 including a variable restriction between said water inlet and said pressurized water source, and a restrictive passage between said water and cleaning fluid inlets upstream from said variable restriction for injecting water into said cleaning fluid inlet when said water inlet is substantially restricted.

23. A cleaning device according to Claim 22 including a check valve on the outlet of said water source to prevent flowback into said water source.

24. A cleaning device according to Claim 22 further including a variable restriction between said mixing means and said spray nozzle to vary the rate of flow to said spray nozzle.

25. A cleaning device according to Claim 18 further comprising a first fitting having an inlet connected to said water source, and a main outlet connected to said water inlet of said mixing means and a restricted outlet, and a second fitting having a primary inlet connected to said cleaning fluid source, a secondary inlet connected to said first fitting's restricted outlet and an outlet connected to said cleaning fluid inlet of said mixing means.

26. A cleaning device according to Claim 25 including a variable restriction on said water inlet of said mixing means, and wherein said first fitting's restricted outlet injects water into said second fitting's secondary inlet when said water inlet of said mixing means is substantially restricted.

27. A cleaning device according to Claim 25 wherein said first fitting is mounted on the top of said water source and said first fitting's inlet has a vertical axis.

28. A cleaning device according to Claim 27 wherein said first fitting's main outlet's axis is orthogonal to said inlet's axis and said first fitting's restricted outlet's axis is coincident with said inlet's axis.

29. A cleaning device according to Claim 28 wherein said second fitting's primary inlet's axis is coincident with the axis of said secondary inlet's axis and said secondary fitting's outlet's axis is orthogonal to said primary inlet's axis.

30. A cleaning device according to Claim 18, further comprising:

control means for said mixing means, said control means determining the mixing ratio of water and cleaning fluid and controlling flow of mixture to said nozzle, said control means having first actuator means connected to said mixing means for controlling the flow to said nozzle and second actuator means connected to said mixing means for selecting said mixing ratio.

31. A cleaning device according to Claim 30 further characterized in having a common linkage connecting said first and second actuator means to said control means.

32. A cleaning device according to Claim 31 wherein said first actuator means is capable of moving said linkage a first maximum distance and said second

second maximum distance greater than said first maximum distance.

33. A cleaning device according to Claim 32 wherein said linkage is connected directly to said second actuator means, said first actuator means being connected to said second actuator means by moving said linkage by moving said second actuator means.

34. A cleaning device according to Claim 33 wherein said connection of said first and second actuator means includes a slot in said first actuator means to allow said second actuator means to move said linkage independent of said first actuator means.

35. A cleaning device according to Claim 30 wherein said cleaning device has a handle, and said first and second actuator means are on opposite sides of said handle so as to be operated by a single hand.

36. A cleaning device according to Claim 30 wherein said control means includes first restriction means connected to said mixing means outlet for controlling the flow to said nozzle, and second restriction means connected to the water inlet of said mixing means for determining the said mixing ratio.

37. A cleaning device according to Claim 36 wherein said first restriction means includes a first anvil and a first hammer adjacent to said mixing means outlet whereby the position of said first hammer relative to said first anvil determines the flow to said nozzle, and said second restriction means includes a second anvil and a second hammer adjacent to said water inlet whereby the position of said second hammer relative to said second anvil determines said mixing ratio.

38. A cleaning device according to Claim 37 wherein said first and second hammers are portions of a rocker arm separated by the pivot point of said rocker arm.

39. A cleaning device according to Claim 38 wherein said rocker arm is connected to said linkage.

40. A cleaning device according to Claim 39 further characterized in that said rocker arm is biased to a position having said outlet completely restricted by said first hammer and anvil, and said actuator means overcomes said bias upon moving said linkage.

41. A cleaning device according to Claim 18 further comprising, a source of pressurized air, said spray nozzle being connected to said air source for educing

fluid from said fluid source using said pressurized air and forceably spraying said fluid onto a surface to be cleaned, and said spray nozzle including an air manifold connected to said air source and having a plurality of nozzle channels, a fluid manifold connected to said fluid source in having a plurality of fingers extending therefrom, each finger being positioned in a respective nozzle channel so that pressurized air flowing through such channels educes fluid from said fingers.

42. A cleaning device according to Claim 41 wherein the axes of said nozzle channels are positioned relative to each other in a fan shape.

MACHINE FOR CLEANING SURFACES SUCH AS CARPETS, FLOORS AND THE LIKE

DESCRIPTION

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to cleaning devices and more particularly to an improved machine for the cleaning of surfaces such as carpets, floors and the like.

In carpet cleaning machines, a liquid is projected onto the carpet and the dirty liquid is removed by a suction nozzle. An air-liquid separator is generally provided to remove air from the dirty, waste liquid and disperse the air into the atmosphere. Cleaning fluid may be added to the liquid. Usually the liquids trickle into a spray nozzle since they are above the spray nozzle. The liquids may be mixed in a mixing manifold. A typical example of such carpet cleaners is illustrated in U.S. Patent 2,986,764 issued June 6, 1961 to D. C. Krammes.

Other systems use various arrangements of tanks, valves and controls to carry out carpet cleaning operations. In spite of all of these efforts directed to the cleaning of floors and carpets, there has not, heretofore, been provided a machine adapted for domestic use which provides effective cleaning of surfaces such as carpets, floors and the like, which is simple to use and sufficiently low in cost to be attractive to domestic users.

Accordingly, it is the object of the present invention to provide an improved machine for cleaning surfaces such as carpets, floors and the like which can be manufactured and sold at low cost and which, nevertheless, is both simple to use and effective in operation.

The objects and advantages of the invention are obtained in a machine having improved arrangements of containers for cleaning fluids, such as shampoos and concentrated cleaning solutions, fresh liquids, such as clean water and for the reception of waste liquids. The machine has a nozzle for projecting the liquids onto the surface to be cleaned and for picking up the waste liquid from the surface. Both the separation of waste liquid and air and the delivery of the liquids is conjointly carried out with suction and air pressure generated in a housing to which a common air pump is connected. The machine is

further improved by facilities for removably attaching the containers to the frame of the machine and for the controlled and selective application of the liquids with different concentrations of cleaning liquid and fresh liquid.

Briefly described, a machine in accordance with the invention for cleaning surfaces such as carpets, floors and the like has a frame. An air pump is mounted on the frame. A housing communicating with the pump has a suction inlet and pressurized air outlets. A suction nozzle is mounted on the frame at the end of the frame which is disposed adjacent to the surface to be cleaned. A liquid projecting nozzle is also mounted on the frame at the end adjacent to the surface to be cleaned. A plurality of containers for concentrated cleaning liquid, fresh and waste liquid are utilized. The containers are removably mounted to the frame and the housing with a conduit connecting the housing and the waste liquid container to communicate waste liquid separated from air and liquid transported into the housing to the waste liquid container. A conduit for air and waste liquid from the suction nozzle is connected to the suction inlet of the housing. A coupling between the pressurized air outlets, the cleaning fluid container and the fresh liquid

container provide for the pressurization thereof. A further coupling is connected to the outlets from the fresh liquid and cleaning liquid containers, in which coupling the fresh and cleaning liquids flow together to an outlet to the liquid projection nozzle so as to apply the fresh and cleaning liquids to the surface. This coupling utilizes simplified mixing and valving to control the flow of the liquid to the liquid projecting nozzle and to provide selected concentrations of the cleaning liquid and the fresh liquid.

Other features and advantages of the invention are provided by the arrangements used for assembling the containers, for providing the pressurized air and suction, and for separating waste liquid picked up from the surface to be cleaned from the air, the container for the cleaning liquid which is adapted to be readily attached and removed from the housing of the machine and the liquid projection and spray nozzles themselves.

The foregoing and other objects, features and advantages of the invention, as well as the presently preferred embodiment thereof will become more apparent from a reading of the following detailed description in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective of a cleaning device incorporating the principles of the present invention.

Figure 2 is a side view of the cleaning device of Figure 1.

Figure 3 is a partial cross-sectional view of the cleaning device.

Figure 4 is a cross-sectional view of the spray nozzle incorporating the principles of the present invention.

Figure 5 is a plan view of a control switch and mixer in its initial closed position incorporating the principles of the present invention.

Figure 6 is a cross-sectional view taken along lines 6-6 of Figure 5.

Figure 7 is a plan view of the control switch and mixer in its spotting position.

Figure 8 is a cross-sectional view taken along lines 8-8 of Figure 7.

Figure 9 is a cross-sectional view of the trigger and spotting actuator assembly incorporating the principles of the present invention.

Figure 10 is a top view of a portion of the water tank and separator assembly.

Figure 11 is a combined cross-sectional view taken along lines 11-11 of Figure 10 and a fluid schematic of the fluid system incorporating the principles of the present invention.

Figure 12 is a back view of the separator housing incorporating the principles of the present invention.

Figure 13 is a partial cross-section taken along lines 13-13 of Figure 12.

Figure 14 is a top view of the separator taken along lines 14-14 of Figure 3.

Figure 15 is a top view of the water tank taken along lines 15-15 of Figure 3.

Figure 16 is a top view of the waste fluid tank taken along lines 16-16 of Figure 3.

Figure 17 is a cross-sectional view of the cam latch device in its unlatched position.

Figure 18 is a side view of a cleaning fluid cartridge incorporating the principles of the present invention.

Figure 19 is a top view taken along lines 19-19 of Figure 18.

Figure 20 is a cross-sectional view taken along lines 20-20 of Figure 18.

Figure 21 is a perspective of a collar incorporating the principles of the present invention.

Figure 22 is a cross-sectional view of the cartridge and docking port incorporating the principles of the present invention.

Figure 23 is a cross-sectional view of the suction nozzle taken along lines 23-23 of Figure 24.

Figure 24 is a perspective view of the suction nozzle.

DETAILED DESCRIPTION

A cleaning device according to the present invention is illustrated in Figures 1, 2 and 3 as including a frame 30 to which are mounted a pair of wheels 32 by strut 34. As illustrated in Figure 2, the wheels are in their operable position allowing the cleaning device to move across the surface to be cleaned. For the stored position, the wheels are rotated forward or counter-clockwise in Figure 2 and comes to rest below the front end of the frame 30. Extending from the top end of the frame 30 is a handle 36 having fluid activation trigger 38 and a spotter actuator 40. Mounted to the front end of the frame is a spray nozzle 42 for projecting cleaning fluid mixtures onto the surface to be cleaned and a suction nozzle 46 mounted to pipe 44 for removing fluids from the surface to be cleaned.

A water tank 48 and waste fluid or return tank 50 are connected as a single unit including a handle 52. The tanks are removably mounted to the frame 30 and are secured thereto by a cam latch 54 engaging the bottom of the waste fluid tank 50. An upper housing 56 mounted to frame 30 above the tank unit includes an air fluid separator 58, a motor 60 and a pump or fan 62 as illustrated in Figure 3. An opening 57 is provided in the upper housing 56 to view the fluid in the separator 58 which has a transparent body. An electrical switch 63 activates the motor 60 and an electric cord 65 provides power.

A container or cartridge of detergent, shampoo or other concentrated cleaning fluid 64 including a collar 66 is mounted to docking port 68 in the upper housing 56 as illustrated in Figure 2. The cleaning fluid is mixed with water from the water tank and projected through spray nozzle 42.

Initially, the water tank 48 is filled with fluid and mounted to the frame 30 and securely held thereto by cam latch 54. A concentrated cleaning fluid cartridge 64 is mounted into docking port 68. Now the system is ready for operation. As will be explained more fully below, the cleaning device operates by activating the motor 63 to turn on the motor to operate the fan and pump 62 to create a force to project a mixture of cleaning fluid and water out of spray nozzle 42 on the surface as well as to create a suction to draw fluid through suction nozzle 46. With the trigger 38 in its normal position, no fluid is dispensed. Upon depressing trigger 38, the amount of fluid projected from spray nozzle 42 can be controlled. If a stubborn stain or especially dirty surface is to be cleaned, the spotting actuator 40 is operated to increase the mixing ratio of detergent to water. The dirty or waste fluid from suction nozzle 46 is provided to separator 58 wherein the air is separated from the dirty fluid which is provided to waste fluid tank 50. The air is provided back through the fan/pump 62 to be re-introduced to the spray nozzle 42. Once the cleaning is done, the tank assembly is removed by

releasing cam latch 54 and the contents of the waste fluid tank 50 are emptied. This cycle of operation may be repeated.

The spray nozzle 42, which is illustrated in detail in Figure 4, is an air venturi system which draws a cleaning fluid mixture and projects it onto the cleaning surface. Spray nozzle 42 includes an air manifold having two complementary pieces 70 and 72 joined along a line or plane 74 (see Figure 2). As illustrated in detail in Figure 4 with the top air manifold 72 removed, the nozzle of the air manifold is generally fan-shaped having a plurality of nozzle channels 76 extending therethrough. Unitary to the air manifold is an inlet tube or conduit 78 connected to a source of pressurized air or the output of the fan 62. Mounted interior the air manifold is a fluid manifold 80 having a plurality of fingers 82 extending therefrom and lying in the nozzle channels 76. Supports 84 and 85, which are integral with the air manifold elements 70 and 72, position the fluid manifold 80 and its fingers 82 central within the air manifold and supports 84 and the nozzle channels 76. The fluid manifold 80 includes an inlet 86 extending through the back wall of the air manifold and is connected by tubing 88 to the source of a cleaning fluid mixture.

Air introduced into conduit 78 moves through the air manifold around the liquid manifold 80 and fingers 82 and exit nozzle channels 76. The restriction of the air through the

nozzle channels creates a venturi effect so as to draw or educe cleaning fluid mixture from the fingers 82 to be forceably ejected onto a surface to be cleaned. Although the system has been designed to operate on a pure eduction principle, it is preferred that the source of cleaning fluid mixture be pressurized so as to maintain an even flow of cleaning mixture fluid to the spray nozzle 42. Since the principle force to draw the cleaning fluid mixture is the venturi effect produced by the air manifold, the pressure provided to the cleaning fluid source is substantially smaller than that provided to the air manifold.

The cleaning fluid mixture provided to the spray nozzle 42 by tubing 88 is from a control switch and mixer illustrated specifically in Figures 5-8 and operated by the trigger actuator 40 and the spotting actuator 38 illustrated in detail in Figure 9. A mixing V or connector 90 which is mounted to the frame 30 has a mixing outlet connected to tube 88, a water inlet connected to tube 92 and a cleaning fluid inlet connected to tubing 94. The water from tube 92 and the cleaning fluid from tube 94 are mixed in the V 90 and provided to outlet tube 88. Engaging one side of the outlet tube 88 is an anvil 96 and adjacent one side of the water inlet tube 92 is an anvil 98. Pivotally connected to the frame 30 at 100 is a rocker arm 102 having hammers 104 and 106 respectively on opposite sides of the pivot 100. A biasing means or spring 108 is received in a

spring housing 110 on the frame 30 and engages the rocker arm 102 around post 112. The biasing means or spring 108 biases the rocker arm 102 counter-clockwise in Figure 5. A slot 114 in the rocker arm 102 receives a control link or wire 116 connected to the spotter actuator 40 and the trigger 38.

Without operation of the trigger 38 or spotting actuator 40, spring 108 rotates the rocker arm 102 to its initial position illustrated in Figure 5 such that hammer 104 is pressed against anvil 96 completely restricting the tubing 88 at the outlet of the mixer 90. This is illustrated specifically in the cross-section of Figure 6. In this position, no cleaning fluid mixture is provided to the spray nozzle 42. Thus, if the electric motor is actuated, only air is blown onto the surface to be cleaned. This could produce an air drying if desired.

With movement of the control wire 116 to the right, the rocker arm 102 rotates counter-clockwise moving the hammer 104 away from the anvil 96 so as to begin to open the closed outlet tube 88. Dependent upon the amount of motion of wire 116 and pivotal rotation of rocker arm 102, the flow rate of cleaning fluid mixture can be controlled. The rocker arm 102 can be rotated to a position allowing unrestricted flow of the outlet tube 88 as well as unrestricted flow from water inlet tubing 92.

Further rightward motion of wire 116 and counter-clockwise rotation of rocker arm 102 causes hammer 106 to engage the

water inlet tube 92 and being restricting its flow into the mixing V 90. The degree of restriction of water inlet 92 permitted is defined by a stop 118 and is illustrated in Figures 7 and 8. This restricted position of water inlet tube 92 defines a specific ratio of concentrated cleaning fluid from tube 94 and water from tube 92 to remove stubborn stains or spots and is known as the spotting position.

Thus, it can be seen that the rocker arm 102 sequentially operates from a first position illustrated in Figure 5 wherein the outlet is restricted by anvil 96 and hammer 104 for zero flow rate through a first plurality of intermediate angular positions having intermediate restrictions of the outlet to define various flow rates and a second plurality of intermediate angular positions having intermediate restrictions of the water inlet 92 provided by anvil 98 and hammer 106 to define the mixing ratio. Thus, a single assembly is provided which controls both the flow rate of dispensing cleaning fluid mixture as well as the mixing ratio of cleaning fluid to water. If required, the rocker arm can be reshaped such that hammer 106 will begin to restrict water inlet tube 92 while hammer 104 also restricts outlet tube 88.

The operation of the rocker arm 102 is controlled via wire 116 by the spotting actuator 40 and trigger 38 illustrated in detail in Figure 9. The spotting actuator 40 is pivotally mounted to the handle 36 at 120 as is trigger 38. The control

wire 116 is connected to post 122 on spotting actuator 40. Post 122 lies in a elongated slot 124 in the trigger 38. The spotting actuator 40 extends from the top of the handle while the trigger 38 extends from the bottom of the handle. This allows activation of either control with the same hand that holds and directs the cleaning device. The spotting actuator 40 may be controlled by the thumb and the trigger 38 by the other fingers which wrap about the handle 36.

Counter-clockwise rotation of trigger 38 as illustrated in Figure 9 from its initial position causes counter-clockwise rotation of the spotting actuator 40 and moves the control wire 116 to the right. The trigger 38 is designed such that the total amount of angular motion which it is capable of travelling is limited to produce via control wire 116 rotation of the rocker arm 102 from the fully restricted condition of outlet tube 88 of mixer 90 to the completely unrestricted condition of outlet tube 88 and no restriction of the water inlet tube 92. The restriction of water inlet tube 92 by hammer 106 is produced by the further motion by travel produced by spotting actuator 40. The counter-clockwise rotation of spotter actuator 40 moves the wire 116 further to the right without further motion of trigger 38 since post 122 moves in slot 124. It should also be noted that spotter actuator 40 may be operated independent of trigger 38 because of the slot 124. The biasing means 108 of rocker arm 102 is sufficiently strong

to clamp the outlet tubing 88 and retains the spotting actuator 38 and trigger 40 in their position illustrated in Figure 9 via wire 116.

The water line 92 and the cleaning fluid line 94 of the mixing V 90 are connected to the fluid circuit illustrated in Figure 11. A block 126 includes an air port 128 and a water port 130. An air inlet nipple 132 and a water outlet nipple 134 are provided in the top of water tank 48. A tube 136 extends down from the water outlet nipple 134 to the bottom of the water tank 48. The nipples 132 and 134 are received in ports 128 and 130 respectively of the block 126. As will be explained more fully below, the block 126 is mounted to the separator 58 to receive the nipples 132 and 134 during mounting of the tank assembly onto the frame as illustrated in Figure 10. A ball 138 in water port 130 acts as a check valve to prevent back flow into the water tank 48.

Connected to the other end of water port 130 is a first fitting 140 having a main outlet 142 connected to the mixing water inlet tube 92 and a restricted outlet 144. The axis of the inlet of fitting 140 is coincident with the axis of the restricted outlet 144 and is orthogonal to the main outlet 142 axis. The cross-sectional area of main outlet 142 is substantially larger than the cross-sectional area of restricted outlet 144. By way of example, the main outlet may have a cross-sectional area four times that of the restricted outlet.

Connected to the first fitting 140 about restricted outlet 144 is a second fitting 146. A primary cleaning fluid inlet 148 of fitting 146 is connected to the concentrated cleaning fluid container 64 by tube 150. The restricted outlet 144 provides a secondary inlet to the second fitting 146. The outlet 152 of the second fitting 146 is connected to cleaning fluid inlet pipe 94 of the mixer 90. The fan or pump 62 provides pressurized air via tubing 154 to an input of the concentrated cleaning fluid container 64 and by tubing 156 to water tank 48 via air port 128. The primary outlet of pump 62 is through conduit 158 to the air manifold of spray nozzle 142.

When the outlet tubing 88 of mixer 90 is totally restricted, no fluid is flowing in the circuitry of Figure 11. Once the restriction of outlet tubing 88 is removed, water under pressure leaves the tank 48 through tubing 136, nipple 134 and port 132 to raise check valve 138 and the flow through main outlet 142 and tubing 92 to the mixing valve 90. Similarly, concentrated cleaning fluid from container 64 flows via conduit 150 and fitting 146 to tubing 94 and mixer 90. In this state, very little water, if any, exits the restricted outlet 144 from the first fitting 140 into the second fitting 146. For spotting or any other condition wherein the water inlet tubing 92 is restricted, the flow in main outlet 142 of fitting 140 is reduced and therefore the flow in restricted outlet 144 is increased. Although this flow introduces water

into the concentrated cleaning fluid, it does not dilute it compared to the unrestricted waterline flow mixture. It also increases the pressure in tubing 94. This allows for greater flow rate of the concentrated cleaning fluid into the mixer 90 and thus the resulting cleaning fluid mixture exiting the mixer 90 has a substantially increased ratio of cleaning fluid to water.

As can be seen from the circuit of Figure 11, the water and the cleaning fluid supply of the system are pressurized. This produces even control of the fluids such that their mixing ratio and flow rate can be assured. The system also takes advantage of the natural siphoning effect which results from the venturi spray nozzle 42.

Realizing this, the pressure provided by pump 62 via tubing 154 and 156 to the concentrated cleaning fluid supply and the water supply respectively is small compared to the overall air pressure provided via conduit 158 to the venturi spray nozzle 42. Although the pressure supply via tubing 154 and 156 is small, it is very important that it be constant to maintain the desired mixing ratio and flow rates. It should also be noted that by providing the water outlet on the top of tank 48 and the secondary passage 144 of fitting 140 being vertical, the force of gravity helps to further reduce the amount of fluid flowing through restrictive passage 144 into the concentrated cleaning fluid fitting 146.

A pump capable of producing the high air flow rate for the venturi spray nozzle as well as a uniform small flow rate for the pressurized water and cleaning fluid containers is illustrated specifically in Figures 3 and 12-14. The separator 58 includes a substantially cylindrical housing 160 with a top rim 162 which forms the housing for the fan or air pump. The pressurized air exiting the chamber formed by the wall of the rim 162 enters tangentially as illustrated in Figure 14 to a first portion 163 of primary outlet 164. The conduit 158 connected to the venturi spray nozzle is connected to second portion 165 of primary outlet 164.

A pair of secondary smaller outlets 166 and 168 are provided in a wall 169 of the primary outlet 164 and aligned parallel to the flow axis of the second portion of the primary outlet 164. The axis of the secondary outlets 166 and 168 are perpendicular to the flow axis of the second portion of the primary outlet. A ledge or wall 167 extends transverse to the flow axis of the second portion 165 of the primary outlet 164 to create a zone of relatively constant pressure compared to the remainder of the primary outlet. The secondary outlets are adjacent the ledge 167 in this zone. As is evident from the drawings, the cross-sectional area of the primary outlet 164 is quite substantially larger than the cross-sectional area of the secondary outlets 164 and 166. This particular structure provides a uniform pressure at secondary outlets 166 and 168.

An air inlet 170 to the separator housing 160 is illustrated in Figure 12 and provides a flow axis tangential to the cylindrical separator housing 160. This causes a centrifugal flow within the interior. A conical shroud 172, illustrated in Figure 3 interior the cylindrical housing 160 has interior thereto an air outlet 174 covered by screen 176. The shroud 172 and the outlet 174 are an integral part of plate 178 which is mounted to the cylindrical separator housing 160. Fluid outlet 180 at the bottom of the cylindrical housing is provided at the bottom of the cylindrical separator housing 160. The outlet 174 is displaced vertically and horizontally from the lower edge of the conical shroud 172. Dirty fluid and air enter the separator housing 160 through opening 170 and begin a spiraling down and out motion. The shroud 172 forces the air fluid mixture to the outside of the cylindrical housing or that portion having a greater radius and velocity.

By using a conical shroud, the area at the entry port 170 is not diminished to retard flow of the mixture into the separator chamber while directing the downward moving mixture to the highest velocity portion of the flow thereby maximizing separation of the air and the liquid. The heavier fluid moves towards the cylindrical housing 160 and continues down through outlet 180. The lighter air turns a sharp angle and exits through screen 176 and outlet 174 into the fan or pump 62. The position of the outlet 174 should not be too close to the outer

edge of the shroud, otherwise the exiting air will not be completely separated from the fluid. Similarly, if the outlet 174 is displaced too far from the edge of the shroud, the system will choke. The liquid outlet 180 of the separator 58 is connected to the waste fluid tank 50 by a conduit 181.

The tank assembly including fresh water tank 48 and waste fluid tank 50 is illustrated in Figures 3, 15 and 16. The clean water tank 48 includes a U-shaped keyway 184 extending along its length. In the top portion of the keyway as illustrated in Figure 15 lies the conduit 181 connecting the liquid outlet 180 of the separator 58 and the inlet to the return or dirty fluid tank 50. In the bottom of the keyway mounted to the frame 30 are received air conduit 158 providing pressurized air to the spray nozzle and return conduit 173 bringing waste fluid back from the suction nozzle 46. Thus, the air and fluid conduits 158 and 173 respectively form the key for the tank assembly or unit keyways. Similarly, as illustrated in Figure 16, the return tank 50 also has a longitudinal U-shaped keyway 185 receiving conduits 158 and 173.

The conduit 181 is flared at 182 at its upper end to provide a funnel and includes a flange 183 extending therefrom to engage the top of the fresh liquid water tank 48 and provide the handle 52 for carrying the tank units. The lower end of conduit 181 includes a rim 191 which is received in an indenture 188 in the neck 190 extending from the return tank 50

into the keyway 184 of the fresh water tank 48. The base 193 of neck 190 is rectangular and is received in rectangular shoulder 195 in the bottom of water tank 48. The fresh water tank 48 has an inlet 186 covered by cap 187 which is secured to the handle 52.

To assemble the tank unit, the waste fluid tank 50 is inserted onto the lower end of the clean water tank with the neck 190 extending into the keyway 184 and base 193 in shoulder 195. The conduit 181 is then inserted from the other end snapping ridge 191 into indenture 188 to mount the conduit to the waste fluid tank and securely mount the clean water tank and the waste fluid tank together. It is evident that the neck 190 and base 193 of the waste fluid tank extending into the keyway and shoulder of the clean water tank 48 stabilizes the tank assembly.

A portion 192 of keyway 185 of the waste fluid tank 50 is inclined to receive a conduit 194 between the fluid return conduit 173 and tube 44 leading to the suction nozzle 46. The bottom of the tank 50 includes a recess 196 (Figure 1) having a camming surface 198 therein. As illustrated in Figure 3, the cam latch 54 lies in the recess 196 and rests against the camming surface 198 of the return tank 50. As will be explained more fully, the cam latch 54 will be rotated into recess 196 to initially align and ride on camming surface 198 to move the tank assembly along the keys formed by conduits 158

and 173 into alignment with the upper housing 56. This mates the flared portion 182 of conduit 181 with the outlet 180 of the separator 58 as well as nipples 132 and 134 into port 128 and 130 respectively of block 126.

As illustrated in Figures 3 and 17, the cam latch 54 includes a substantially L-shaped handle 203 having a camming surface 201 and a lever portion 203. The camming surface 201 engages the camming surface 198 in the bottom of the waste fluid tank 50. The handle 54 is pivotally mounted at its lower end at 205 to the block 207 of the frame 30. An L-shaped latch 209 is pivotally connected at 211 the juncture of the legs to the L-shaped handle 203. A spring 213 engages the interior of handle 203 and one of the legs of latch 209 to bias the latch counter-clockwise relative to the handle as illustrated in Figures 3 and 17. A ridge or shoulder 215 in the block 207 forms a catch for a leg of latch 209 which acts as a detent to lock the cam latch in the position illustrated in Figure 3. The unlatch position, allowing removal of the tank assembly from the cleaning device, is illustrated in Figure 17.

In order to release the cam latch 54 from the position illustrated in Figure 3, the latch 209 is rotated clockwise against the spring 213 with the handle 203 stationary allowing the detent and the latch 209 to ride out of the cam latch or ridge 215 on block 207. The cam latch 54 may then be rotated counter-clockwise. To mount the tank assembly to the cleaning

device, the tank assembly is mounted with the keyways 184 and 185 on the keys formed by conduits 158 and 173 and 194. The cam latch 54 is rotated back into recess 196 in the bottom of return tank 50 and engages camming surface 198. The detent portion 20 of latch 209 rides along the exterior edge 217 of block 207 until it exceeds the top thereof and falls into the catch 215.

The unique cartridge 64 including collar 66 is illustrated in Figures 18-21. The cartridge 64 includes a non-circular body 200 having a neck 202 extending therefrom. Threaded portions 204 on neck 202 receives cap 206. A circumferential ridge 208 on neck 202 retains the collar 66 between the top of the cartridge and the ridge 208 such that the collar may rotate relative to the cartridge 64 without any axial motion between the collar and cartridge. The sides of the cartridge adjacent the top includes four indentures 210, 212, 214 and 216. Indentures 210 and 212 receive a handle 218 extending from collar 66 to define two distinct positions of the collar relative to the body. As will be explained more fully below, when the handle 218 is in recess 210, the collar 66 is in its initial angular position capable of entering into the docking port 68 of the cleaning device. As the collar 66 is rotated counter-clockwise in Figure 19, the handle will be received in recess 212 which will define a final locked angular position of the collar in the docking port. It should also be noted that

the recess 210 allows the handle to be received substantially within the body 200 and therefore allows for easy packaging.

The collar 66 includes a pair of camming recesses 220 therein to receive a pair of tabs in the docking port of the cleaning device. Each recess 220 includes an entry slot 222 on the top of the collar connected respectively to a inclined portion 224 followed by a horizontal lock portion 226. A pair of lugs 260 (Figure 22) on the docking port 68 are received in entry slots 222 and the collar is rotated relative to the body causing the total assembly to move axially without rotation of the cartridge 64. The lugs 260 ride down the inclined portion 224 along portion 226 to lock the collar and cartridge in place in the docking port. The locking portion 226 prevents reverse rotation by vibration or use of the cleaning device. Since the cartridge is part of a pressure fluid system, it is important that the docking be firm and secure for proper operation of the cleaning device. Thus, alignment and airtight connection is critical. As illustrated in Figure 21, the collar 66 is formed of two portions connected by an integral lying hinge 228. The collar is wrapped around the neck 202 below ridge 208 with latch 232 locking on top of catch 230.

Indentures 214 and 216 receive shoulders or keys in the docking port to align and restrain the cartridge from rotating during axial insertion into the docking port by hand as well as by rotation of the collar 66.

Received in the top opening of the bottle neck 202 is an insert 234 having a pair of nozzles 236 and 238 thereon. As will be explained below, these nozzles are aligned with ports in the docking port with nozzle 236 being an air inlet and nozzle 238 being a fluid outlet. The insert 234 has a pair of circumferial ridges 240 which engage and seal the insert against the interior of the neck 202. As previously discussed, this is a positive pressure supply system and therefore this seal must be maintained. An axial keyway 242 is provided in the insert 234 and is received in key 244 running along the interior of the neck 202. This aligns the insert 234 and the nozzles 236 and 238 to the cartridge and consequently to the collar. This assures alignment of the nozzle and the appropriate inlet and outlet of the docking port. A tube 246 extends from the bottom of the body 200 to the fluid outlet nozzle 238.

The cartridge 64 in docking port 68 is illustrated in detail in Figure 22. The docking port is an assembly which includes a docking housing 250 mounted to the upper housing 56. A pair of opposed slots 252 are provided in the docking housing 250. A U-shaped clip 254 is inserted in the docking housing having a pair of nipples 256 and 258 extending through the housing 250 to receive air inlet conduit 154 from the outlet of the pump and cleaning fluid supply tubing 150 leading to the second fitting 146 (see Figure 11). The outer edges of

the U-shaped clip 254 has tabs 260 which engage the bottom of the slots 252 in the docking housing to maintain the clip therein. Extending to the interior of the docking housing are a pair of lugs 262. These lugs form the complementary camming surfaces to be used with the camming recesses 220 in the collar 66. A molded rubber sealing disc 264 is received in the U-shaped clip 254.

By using a clip 254 to be inserted through the docking housing, it can be made of hard material capable of many insertions on the camming surface. For example, it may be made of Delrin plastic. This reduces the cost of the overall device by making the shaped clip of such expensive material instead of requiring the whole docking housing to be so made. The molded rubber seal 264 creates an airtight seal since it receives nozzles 236 and 238 on the container and deforms as the container is moved axially within the docking housing. A pair of shoulders 266 and 268 extend from the housing wall 56 and provide guides or key for indentures 214 and 216 of the cartridge.

As can be seen from Figures 2 and 22, the cartridge 64 lies in a chamber in the upper housing 56 with the neck portion 202 extending into a recess portion and the body 200 lying in a cavity portion of the chamber. The cavity encompasses at least three of the sides of the body.

A cartridge 64 of concentrated cleaning fluid may be mounted to the docking port 68 by aligning the indentures 214 and 216 of the cartridge with shoulders 266 and 268 of the housing, respectively. The collar 66 is placed in its initial or insertion position as defined by the handle 218 lying in indenture 210 of the body. The body and collar are moved axially until the lugs 262 of the docking port are received in entry slots 222 in the top of the collar. The collar 66 is then rotated by handle 218 accessible from the exterior of the cavity causing the body and collar to move axially during rotation of the collar. The indentures 214 and 216 engage the shoulders 266 and 268 to prevent the cartridge 64 from rotating. The collar is rotated to its final or lock position defined by the handle 218 being received in indenture 212 on the body. In this position, orifices in nozzles 236 and 238 are aligned and received with apertures in the base of nipples 256 and 258. The insert 234 having a keyway assures alignment of the nozzles with the body and the camming recess 220 of the collar with tabs 262 assure initial alignment as well as indentures 214 and 216 of the body and shoulders 266 and 268 of the housing assure initial alignment of the body and nozzles during the axial movement of the body produced by rotation of the collar 66.

The suction nozzle 46 of the present invention as illustrated in Figures 23 and 24 is composed of a front-top

piece 270 and a back-bottom piece 272 joined by appropriate fasteners. The nozzle includes a first or inlet passage 274 and a second or outlet passage 276. The inlet passage 274 is generally U-shaped along a cross-section transverse to the flow axis having a flat bight portion 278 and a pair of short leg portions 280. The front flat bight portion 278 has a substantially triangular configuration diminishing from the base or nozzle inlet 282 to its juncture 284 with the outlet passage 276. As can be seen from Figure 23, the distance of separation between the front and back portions of the walls of the front and bottom pieces 270 and 272, respectively increase from the base or inlet portion 282 to the juncture 284 between the inlet, first passage 274 and the outlet, second passage 276. This change of distance of separation compensates for the diminishing triangular portion of the front and back faces such that the cross-sectional area of the inlet passage 274 is substantially equal along the flow axis. This allows a uniform draw or suction throughout the inlet passage 278 and prevents fluid from hanging up and flowing back out the inlet 282.

The second passage or outlet passage 276 as illustrated in Figure 23 has a generally triangular cross-section along the flow axis such that its cross-sectional area, transfers to the flow axis, increases along the flow axis. A cylindrical connector portion 285 receives pipe 44 of the housing. The bottom wall 286 of the outlet passage extends diagonally across

the connector inlet 284 (see Figure 3). Thus, the projected axis of the pipe 44 and outlet connector 285 intersects the first, inlet passage 278 below the juncture 284 of the inlet and outlet passages 274 and 276, respectively, and forms an oblique angle therewith. Thus, the outlet passage 276 forms a horizontal trough to collect fluid which will drip from the conduits between the nozzle 46 and the fluid separator 58 when the motor and suction system are deactivated. Thus, no fluid will exit the outlet 282 when the device is turned off.

In order for the user to determine the condition of the extracted fluid being drawn through nozzle inlet 282, at least the top wall 288 of the outlet section 276 should be transparent. The front, top and sides of the top piece of the nozzle 46 are transparent. This allows viewing of the fluid by the user during use. The operator cannot see the front wall of passage 274 since he generally stands behind the device during use. To further increase visibility of the fluid, the enlarged cross-sectional area of the trough 276 causes a pressure drop to slow down the fluid at the juncture or intersection 284. The bottom wall 286 maintains the fluid adjacent the top wall 288 for better vieweing. When this fluid is slowed down, the exact content and color can be more readily ascertained. It should also be noted that by providing the front or inlet passage 274 as U-shaped, the fluid from legs 280 on entering the outlet passage 276 intersect the primary flow from the

bight portion 280 and create eddy currents at their junction. These eddy currents further slow down the fluid in the viewing area.

To further increase visibility, the back and bottom walls of the bottom piece 272 should be made of non-transparent material. Preferably, they should be white such that additional light may be provided from the back to illuminate the extracted fluids. It should be noted that the outside side walls are extended at 290 to provide a shield for the spray nozzle 42 to prevent water from being sprayed outside the suction nozzle 46.

From the preceding description of the preferred embodiments, it is evident that the objects of the invention are attained, and although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation. The spirit and scope of the invention are to be limited only by the terms of the appended claims.

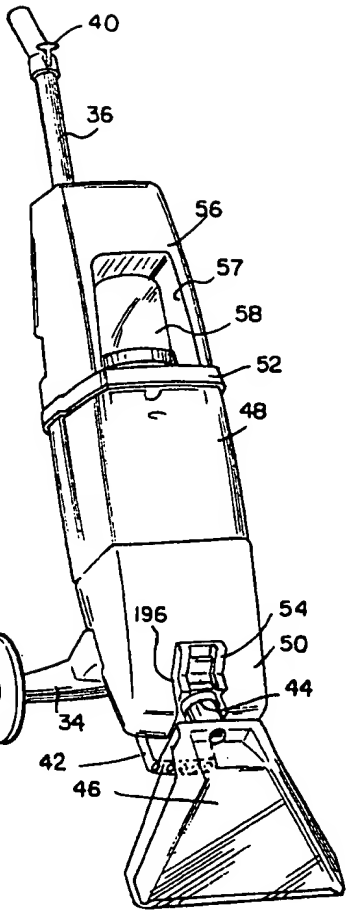

FIG. 1

FIG. 2

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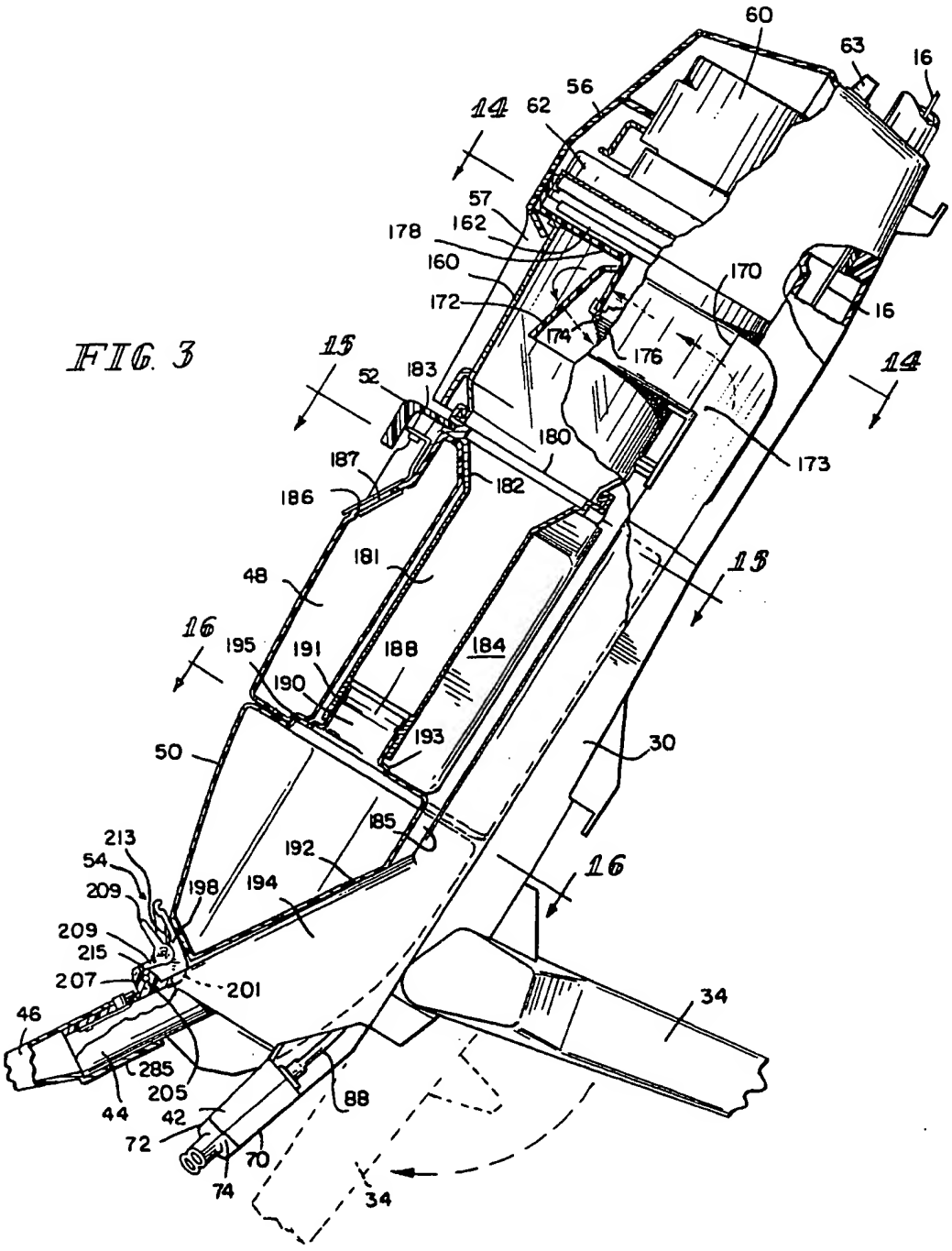
FIG. 3



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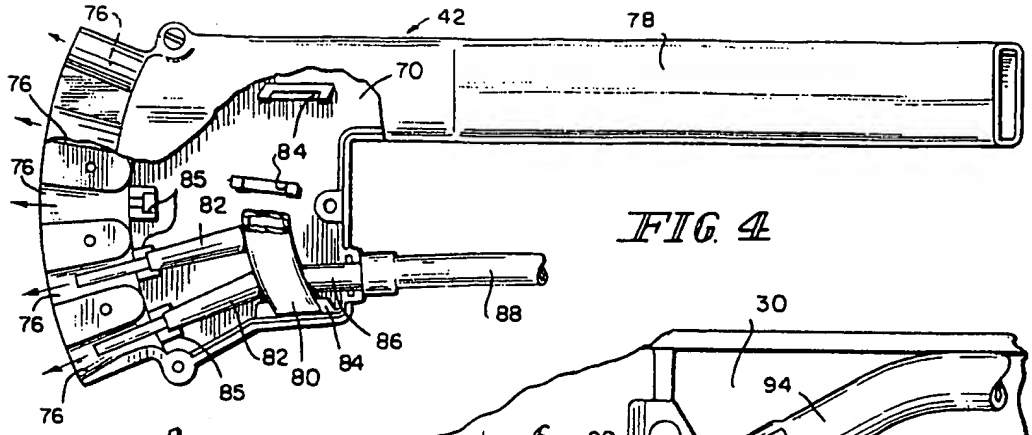

FIG. 4

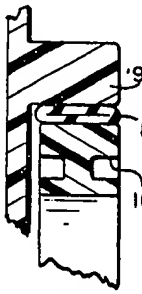

FIG. 6

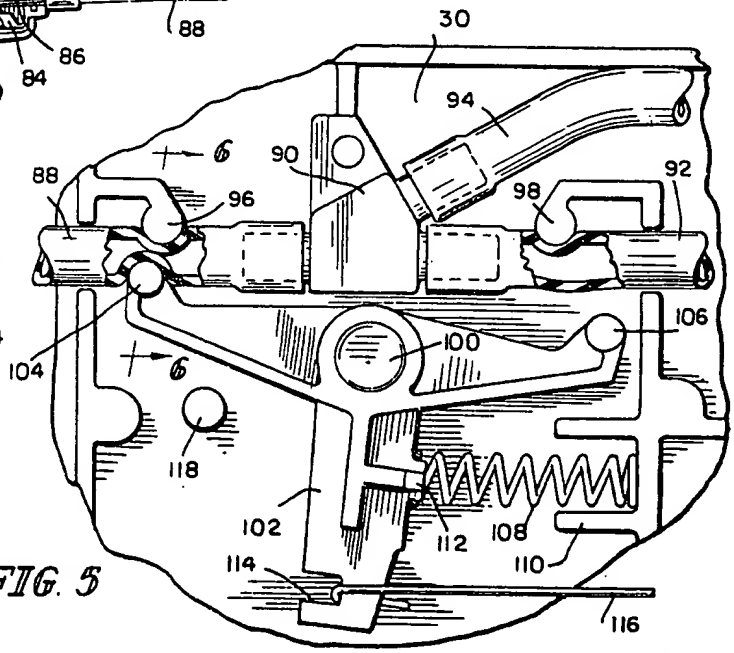

FIG. 5

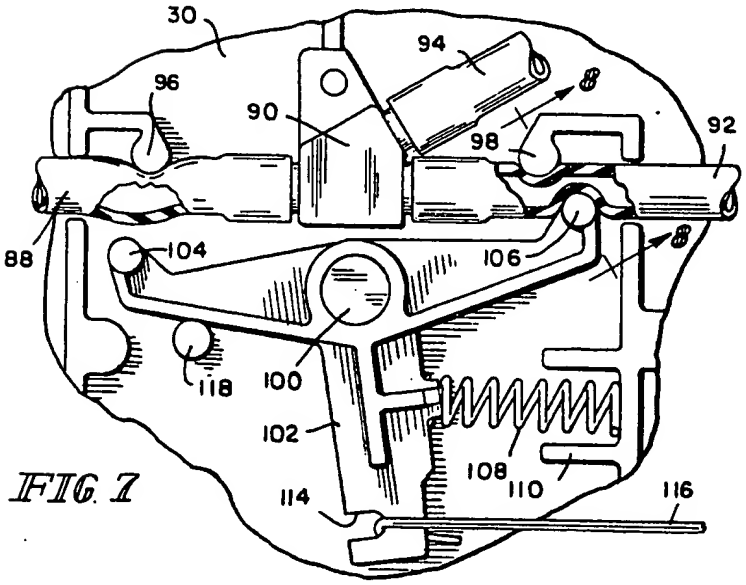

FIG. 7

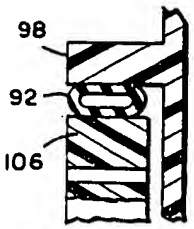

FIG. 8

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FIG. 9

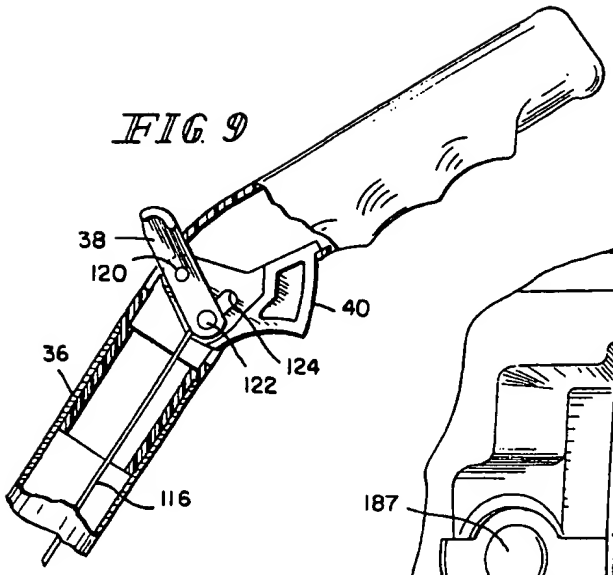


FIG. 10

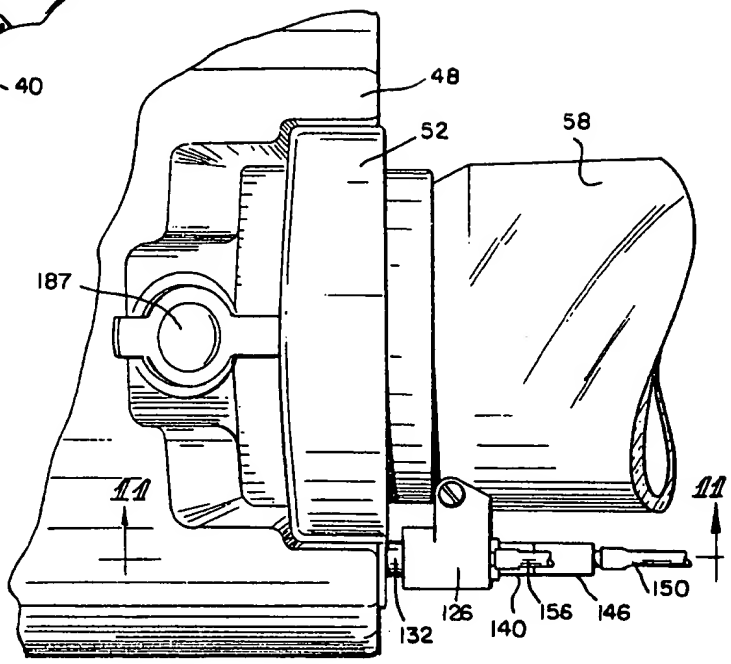
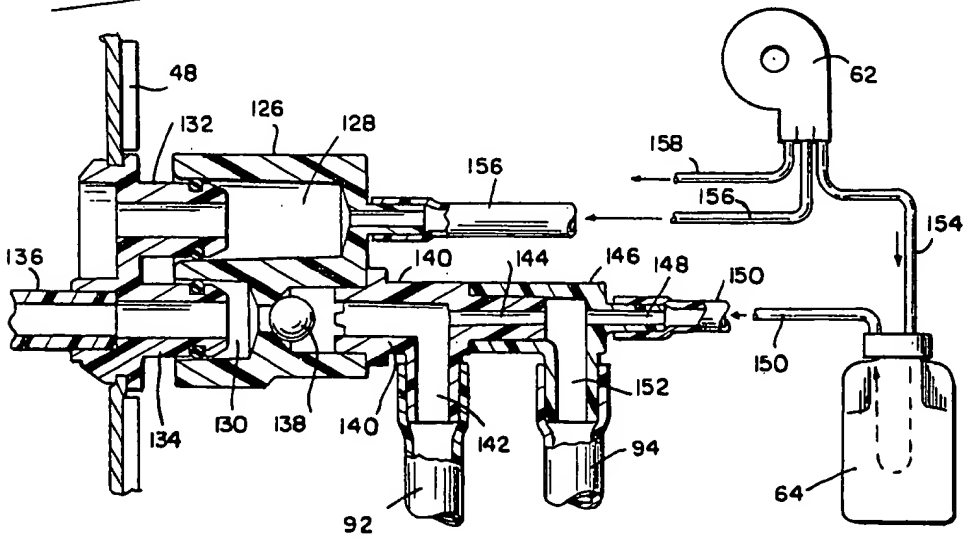


FIG. 11



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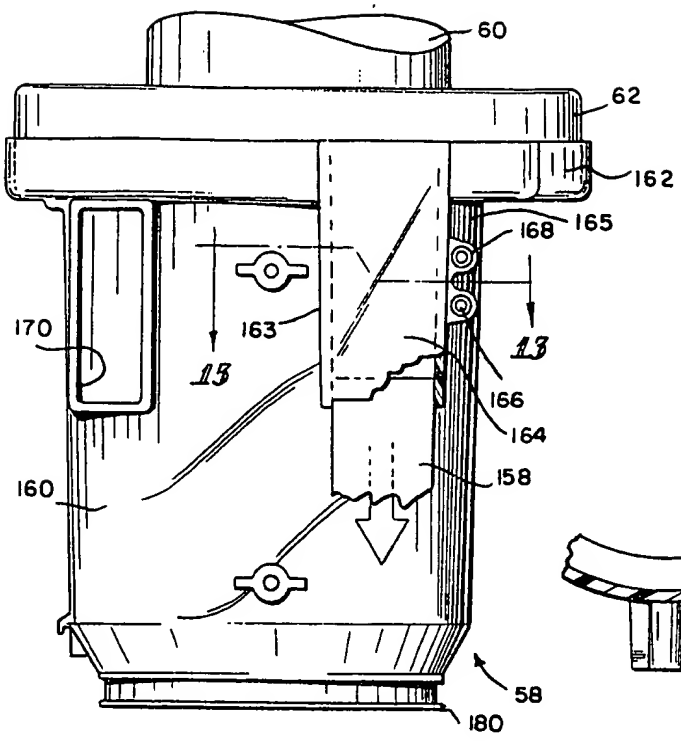

FIG. 12

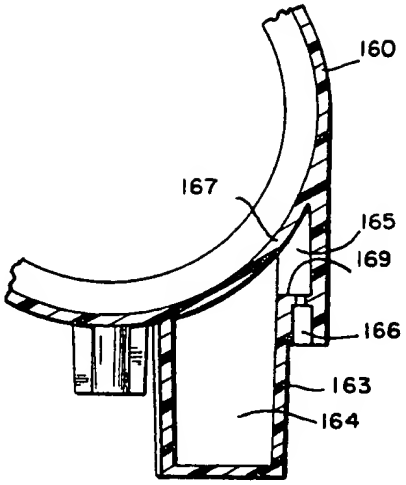

FIG. 13

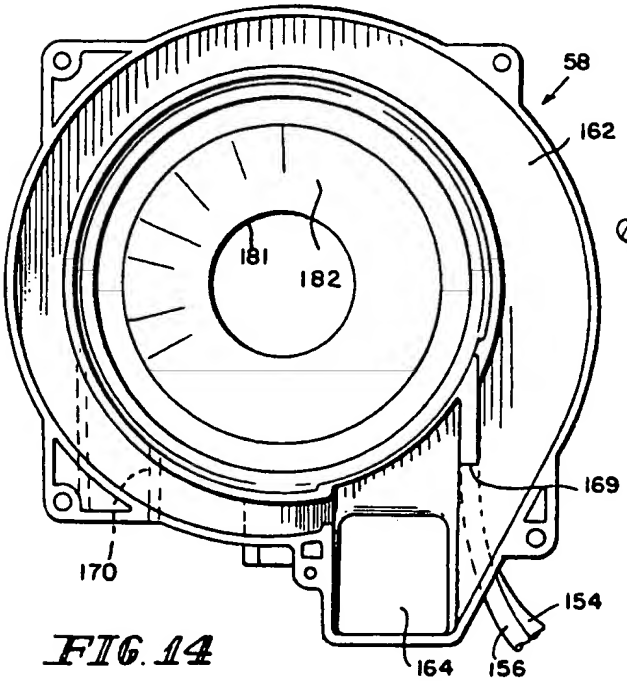

FIG. 14

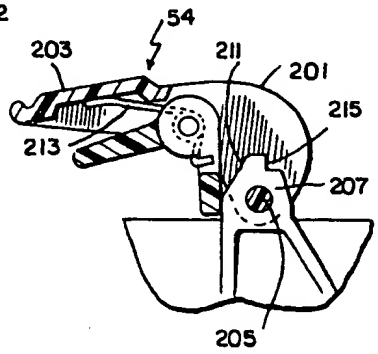

FIG. 17

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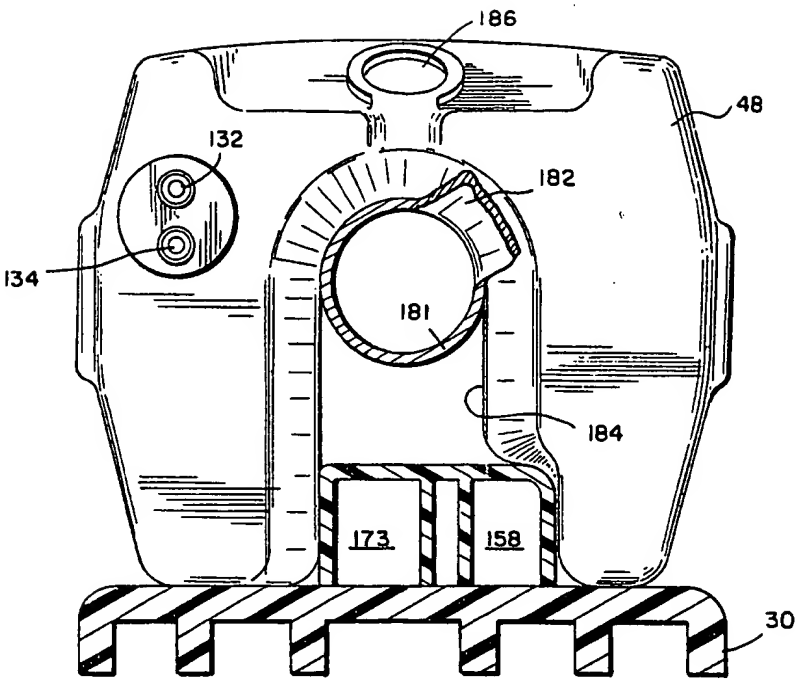

FIG. 15

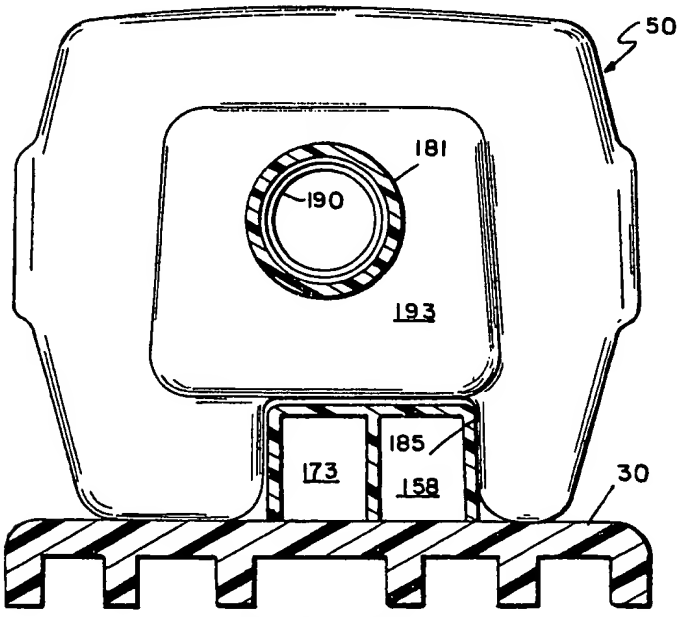

FIG. 16

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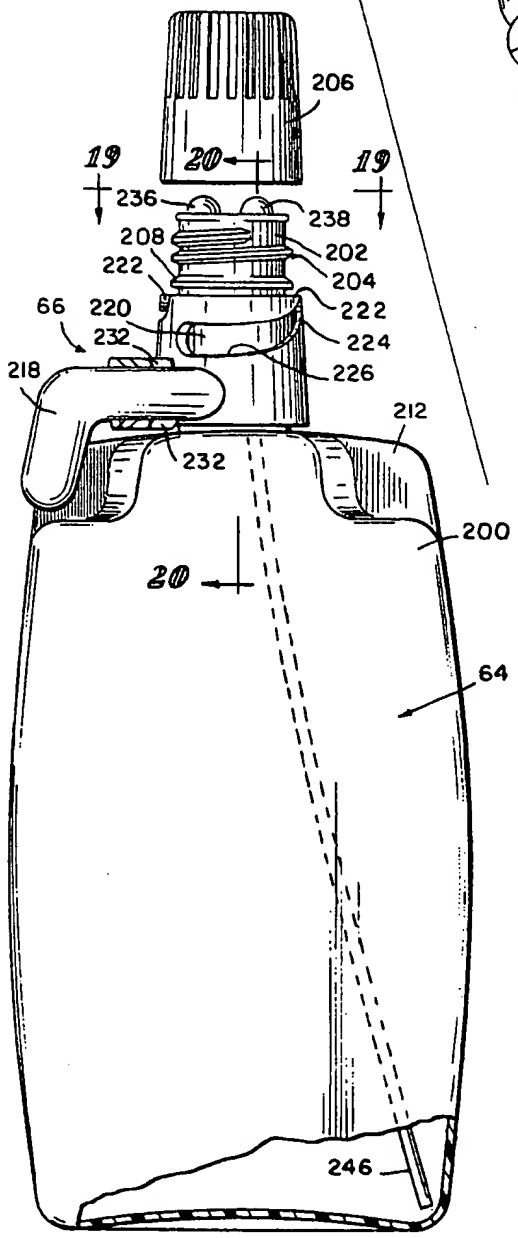
FIG 18



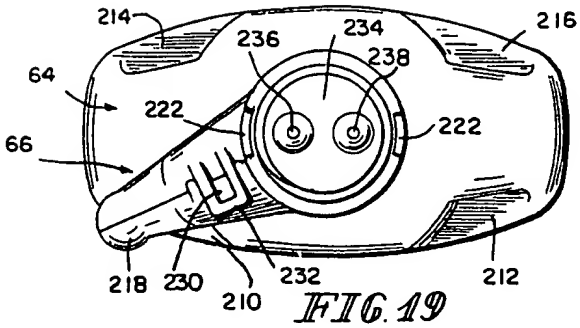


FIG. 19

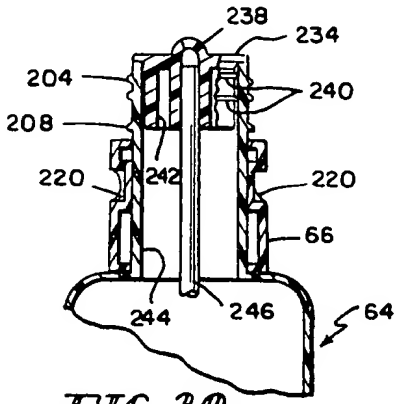


FIG. 20

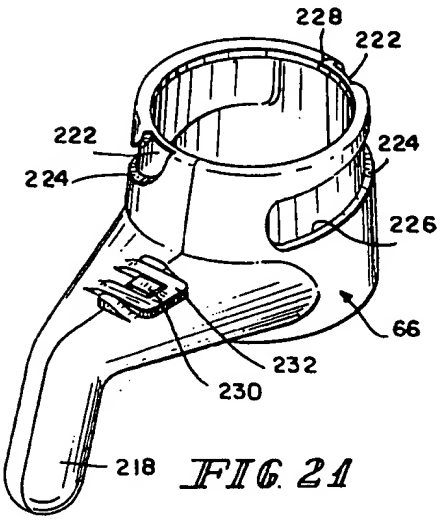


FIG. 21

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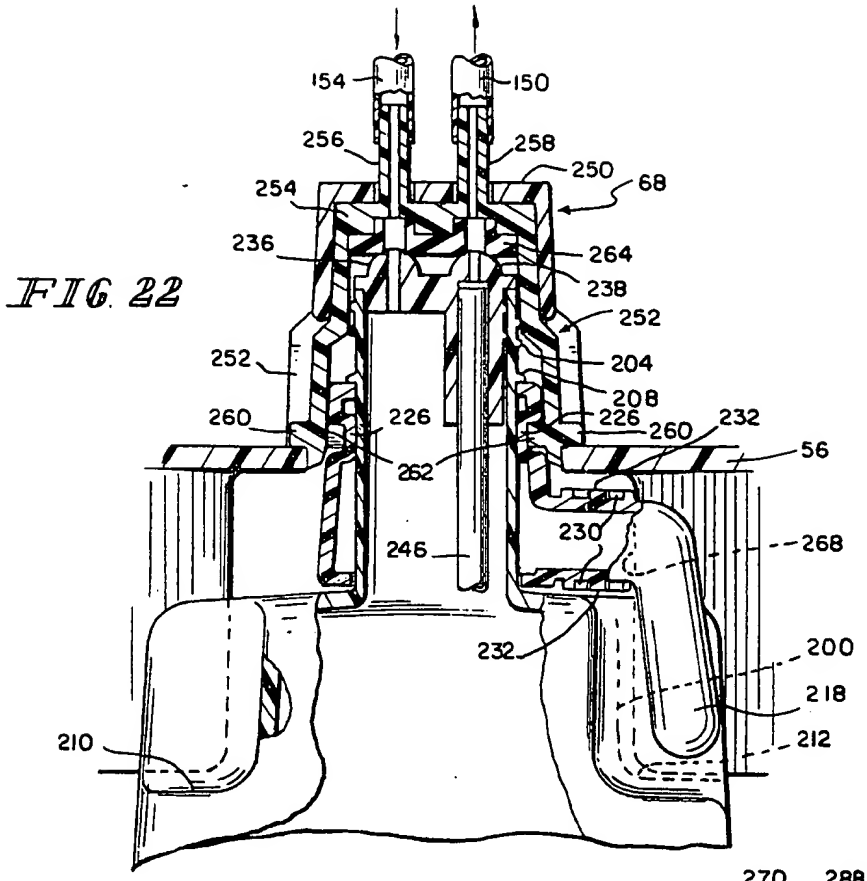
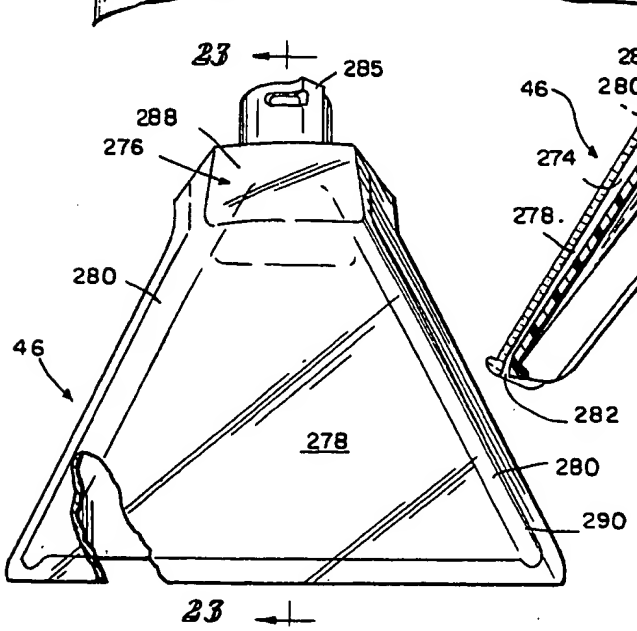


FIG. 22



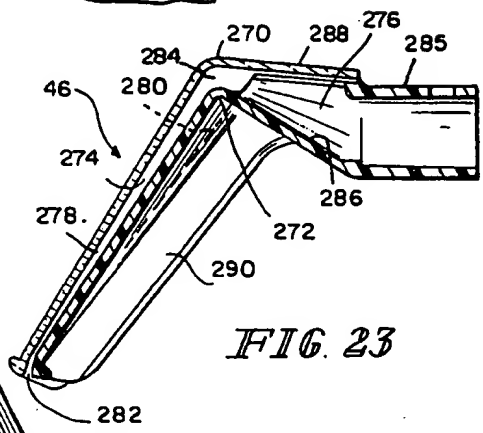


FIG. 23

FIG. 24

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